General Information, REC

Overview

Introduction This section gives some general information about the REC recorder.

Contents This section contains the following topics.

Topic	See Page
General Information	28

General Information

Introduction

REC is a digital printer for real time and/or histogram recordings on thermo sensitive paper.

REC is designed for TCM3 and OXI recordings (not TCM30). The printer automatically distinguish between tc and saturation monitoring, and it automatically records the primary parameters pCO_2 and pO_2 (TCM3)/SaO_2 and pulse rate (OXI) as curves, and secondary parameters such as time, temperature, calibration information and paper speed as alpha-numerical characters.

Data transfer from the monitor to REC is performed in serial mode via a multiple core cable.

REC is powered by 12 VAC which is supplied from the monitor by the same cable that is used for data transmission.

If REC is recording data from TCM3s below RUN 22, it is necessary to power the recorder from its "own" mains adapter via the rear panel AC-input plug.

The recorder's front panel includes two keys:

- Paper speed selection key (2, 5 or 10 mm pr. minute)
- Paper feed key

REC exists in two versions. One for real time recordings and one for real time and/or histogram recordings.

Via a configuration program, included in the software, the recorder can be setup to seven different languages (English, German, French, Spanish, Italian, Russian, Swedish and Danish).

The configuration program, which is called by pressing the paper feed key for 10 seconds, also includes steps for selection between linear and non-linear axis, calibration curve recordings (TCM3 only), and selection between real time and/or histogram recordings (histogram recordings requires histogram software).

For a detailed information, please refer to user manuals for the monitors.

On its right, REC has two lock-screws for snap-on attachment to OXI and TCM3 (for TCM3 from production RUN 22 only).

Software

REC is computer controlled and the software primarily takes care of the following functions:

- Thermal printer control
- Front panel LED and key control
- Reading of alpha-numerical characters from the monitor

The program memory includes a test program for checkout and adjustment of the recorder. For further details refer to "Test Procedures".

Continued on next page

General Information, *Continued*

Hardware

The thermal printer is an Olivetti 2040 20 character printer for printing curves and alpha numerical characters on 80 mm thermo-sensitive paper.

The electronics is mounted on four PCBs.

The Printer Control PCB includes the power supply, the motor control circuit, the control circuit for the 20 position printing head, test points for checkout and adjustments, and the alarm output circuit.

The Display PCB includes four LEDs and two keys.

The Connector PCB includes the necessary connectors and flat-cables for interfacing the thermal printer with the printer control PCB.

The Computer PCB includes the microcomputer NSC 800 with its peripherals.

Specifications

Dimensions

Height 8 cm

Width 12 cm

Depth 23 cm

Weight 1.9 kg

Paper speeds (selected via the front panel)

2 mm/min., 5 mm/min., or 10 mm/min.

Power requirements

12 - 15 VAC through recorder cable or 100/120/220/240 VAC through appropriate mains adapter.

Consumption: Typically 2 VA.

Alarm output

Open collector switch. Max. load 24V/250 mA

Test Procedures, REC

Overview

Introduction

This section details the procedures for testing and adjusting REC. For each of the paragraphs the required tools for testing are listed.

Contents

This section contains the following topics.

Topic	See Page
Introduction	32
Test Procedures	33
Error Codes	35

Introduction

This section describes the necessary procedure for checking and adjusting the REC

Repairs to REC is made only by replacing spare parts listed in the Spare Parts section. Defective PCBs, which are returned to RADIOMETER for exchange. This is to ensure patient and functional safety.

RADIOMETER recommend a yearly preventive maintenance checkout.

Checkout and Adjustment

To carry out the checkout and adjustment procedure, the following tools are necessary:

- 4 1/2 digit True RMS Digital Voltmeter, (the Fluke 8060A is recommended). The accuracy in the DC voltage ranges must be equal to or better than 0.05% + 2 digits.
- Adjustment tool for the trimming potentiometers.
- 5 mm wrench for adjusting the tacho disk.

The Checkout and Adjustment procedure is based on the test software included in the REC program memory.

The test program is called by switching on the REC while the two front panel keys are depressed simultaneously.

The test software includes 6 program steps which are identified by the front panel LEDs.

The LED combination for each program step is shown in the left margin.

The paper feed key is used to step through the test program.

Note

It is recommended to load the mains adapter by the monitor to prevent an overvoltage to influence the checkout and adjustment procedure.

Test Procedures

Self-test

In this step a self-test of the RAM, EPROM, EEPROM, and peripherals is carried out.

Step	Action	Front Panel LEDs
1.	Connect the power to the recorder while the two front panel keys are depressed simultaneously. All 4 LEDs are activated.	● ▶ ▶ ▶
2.	Wait approximately 20 seconds for the self-test to finish. The test program proceeds automatically to the next step.	

Printing Pulse

This procedure is used for adjusting the printing pulse.

Step	Action	Front Panel LEDs
1.	Connect DVM+ to TP3 and DVM- to TP1. Ensure that the DVM is a TRUE RMS type.	● ▶ ▶
2.	Check that the average value of the pulse signal (DVM in the DC voltage range) is 3.30 ± 0.01 V. If outside, adjust R138 on the Printer Control PCB to 3.300 ± 0.005 V.	
3.	Press the paper feed key to proceed to the next program step.	

Motor Amplifier Feed Back

This procedure is used for adjusting the feed back to the motor amplifier.

Step	Action	Front Panel LEDs
1.	Check that the motor is running and that paper is mounted.	● ▶
2.	Connect DVM+ to TP4 and DVM- to TP1 and check that the voltage is approximately 1.30 to 1.40 V. The DVM reading is difficult as the voltage changes during the check. If outside, adjust R126 on the Printer Control PCB to approximately 1.30 V.	
3.	Press the paper feed key to proceed to the next program step.	

Continued on next page

Test Procedures, *Continued*

Automatic Motor Speed

The test program now automatically adjusts the motor speed to 5 micro lines pr. second corresponding to 400 ms between each line interrupt. When the adjustment has been finished, the necessary D/A converter data input is stored in the EEPROM, the motor stops and the stored data is printed on paper as a decimal number.

Step	Action	Front Panel LEDs
1.	Press the paper feed key to proceed to the next program step.	● ▶

Printing Voltage and Tacho Disk

This procedure is used for adjusting the printing voltage and the mechanical position of the tacho disk.

Step	Action	Front Panel LEDs
1.	Connect DVM+ to TP8 and DVM- to TP1 on the Printer Control PCB. Check that the voltage is 17.6 ± 0.4 V. If necessary, adjust R111 on the Printer Control PCB to 17.6 ± 0.4 V.	● ▶
2.	Check that the 3 lines printed on the middle of the paper are straight and regular. If necessary, loosen the tacho disk by a 5 mm wrench and adjust the disk. Fasten the tacho disk after the adjustment.	
3.	Press the paper feed key to proceed to the next program step.	

Test Printout

This procedure generates a printout including the character set and the software version.

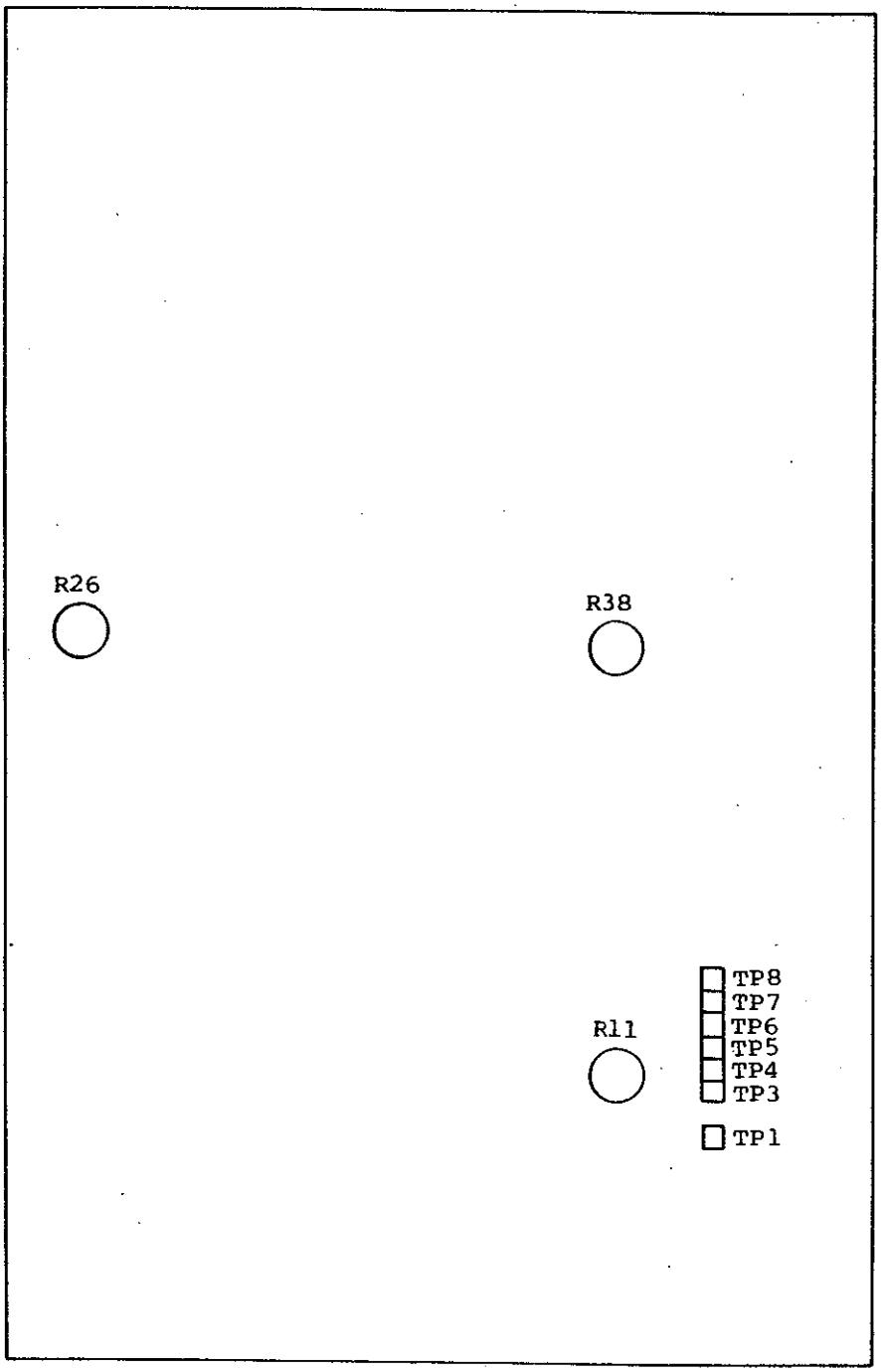
Step	Action	Front Panel LEDs
1.	Check that the alpha numeric character set and the software version number is printed on paper.	● ▶ ▶
2.	The checkout and adjustment procedure except the self-test can be repeated by pressing the paper feed key.	

Error Codes

Error Indications

The table below lists the error codes which is a combination of flashing LEDs. The table also lists the corresponding causes and corrective actions.

Error Code	Cause	Corrective Action
●	Paper run out	Mount a new paper roll
● ▶	Parallel port error	If the error code remains activated after the recorder has been switched off and on, replace the Microcomputer PCB
● ▶	Serial Port error	
● ▶ ▶	RAM error	
● ▶	EPROM error	
● ▶ ▶	EEPROM error	
● ▶ ▶	Motor error	Check the DC voltage in TP4.
● ▶ ▶ ▶		Check that the DC voltage in TP7 is < 21 V
Consecutively left to right flashing LEDs	Software error	If the error code remains activated after the recorder has been switched off and on, replace the Computer PCB



TEST POINTS AND ADJUSTMENT COMPONENTS

COMPONENT SIDE VIEW

PRINTER CONTROL PC-BOARD ASSEMBLY 901-806

Dismantling and Replacement, REC

Overview

Introduction

This section details the procedures for dismantling the REC and replacing parts.

Contents

This section contains the following topics.

Topic	See Page
Procedures for Dismantling and Replacements	38

Procedures for Dismantling and Replacements

Introduction

To dismantle and replace the various parts of the REC, the following tools are necessary:

Pozidrive screwdriver, # 0

Pozidrive screwdriver, # 1

The numbers in brackets refer to the exploded view in section 4.

Cabinet (48)

Step	Action
1.	Disconnect the cables and switch off the recorder.
2.	Remove the paper lid (49), the rear plate (38) and the two bottom screws (19).
3.	Carefully draw the cabinet from the front panel (1).
4.	When replacing the cabinet, ensure that the flat-cable on the recorders' left side is not clamped.

Do not remove the fixation screws (54) or the protection spacers (52) and (53), when dismantling the recorder.

Locking System (56-60)

Step	Action
1.	When attaching the recorder to the monitors TCM3 or OXI, the lock lever (56) should be released, thus preventing the recorder from sliding forward.
2.	When using a TCM3 without the "keyholes" (below RUN 19), the recorder cannot be locked to the monitor and the lock-lever is redundant and can be fastened by the hex-head screw (57).
3.	The lock-house (59), can be released by the four screws (60). Use the #0 pozidrive screwdriver.

Continued on next page

Procedures for Dismantling and Replacements, *Continued*

Front Panel

Step	Action
1.	Remove the four screws attaching the fixation brackets (14) to the two aluminium chassis (21 and 31).
2.	Disconnect the PCB connector from the Printer Control PCB (18) and remove the two fixation brackets (14) by the four screws (16).
3.	Lift off the Display PCB (3) and the front part assembly (4 to 13)
4.	When replacing the entire front section (1 to 16) ensure that the 7-pole cable is not clamped.

Computer PCB

Step	Action
1.	Unscrew the four screws securing the PCB to the stand-offs (32).
2.	Unplug the flat-cable from the Printer Control PCB (18).

Printer Control PCB

Step	Action
1.	Unscrew the four screws securing the PCB to the right and left aluminium chassis (21 and 31).
2.	Unplug the cable connector (40) and the flat-cable (50) from the PCB.

Thermal Printer Unit

Step	Action
1.	Unscrew the 4 screws securing the connector PCB (50) to the two brackets (22).
2.	Carefully unplug the 2 flat-connectors from the Connector PCB (50) and unscrew the 4 screws securing the mounting plate (26) to the left and right aluminium chassis (21 and 31).
3.	Remove the printer unit/mounting plate by lifting and turning outwards the lower edge from the paper guide (17).
4.	Separate the printer unit and the mounting plate by unscrewing the 4 screws (28).

Spare Parts, REC

Overview

Introduction

This section lists the spare parts available for servicing the REC. The spare parts list specifies to which extend the monitors may be serviced as only the spare parts listed may be replaced.

Contents

This section contains the following topics.

Topic	See Page
Available Spare Parts	42

Available Spare Parts

Introduction

All spare parts available for the REC are listed in this section which also includes an exploded view to ease the identification of the parts.

When ordering spare parts include the code number and the description of the part.

Trade-in Parts

The modules marked with an * must be returned to RADIOMETER for replacement. This is to ensure the highest possible degree of patient and functional safety.

They will be replaced in accordance with our Trade-in arrangement for modules, with the exception of modules that have been damaged during attempted repairs.

Histogram Updating

A kit for updating the standard recorder to histogram version, is available under the code no. 904-729. For further details refer to the following pages.

Available Parts

The numbers in the left column refer to the exploded view at the end of this Section.

Ref. No.	Part No.	Quantity	Description
1	927-032	1	Front panel for REC, white
	927-033	1	- yellow
	927-034	1	- pink
	927-035	1	- green
	927-036	1	- blue
2	927-025	1	Set of keys for TCR3/REC
3	901-700	1	* Display PCB assembly for TCR3/REC
4	886-217	1	Right cover plate for TCR3/REC
5	921-425	1	Writing plate for TCR3/REC
6	886-216	1	Left cover plate for TCR3/REC
7	921-426	1	Top cover plate for TCR3/REC
8	921-423	1	Paper tear-off edge for TCR3/REC
9	008-105	7	Screw, M2 x 5 mm
10	042-207	7	Washer, ø 2.2/5 x 0.3 mm
11	009-105	4	Screw, M2 x 5 mm, countersunk
12	041-148	6	Nylon washer, ø 8.7/13 x 1.6 mm

Continued on next page

Available Spare Parts, *Continued*

Available Parts *(continued)*	Ref. No.	Part No.	Quantity		Description
	13	885-730	2		Fixation rail for TCR3/REC
	14	887-433	1		Right fixation bracket
	15	042-359	4		Washer, ø 3.5/9 x 1 mm
	16	008-312	4		Screw, M3 x 12 mm
	17	927-037	1		Paper guide
	18	901-806	1	*	Printer Control PCB assembly
	19	008-306	6		Screw, M3 x 6 mm
	20	009-306	15		Screw, M3 x 6 mm, countersunk
	21	885-762	1		Left aluminum chassis
	22	887-430	2		Bracket for TCR3/REC
	23	885-722	1		Paper roll housing for TCR3/REC
	24	886-219	1		Left paper pin holder for TCR3/REC
	25	886-220	1		Right paper pin holder for TCR3/REC
	26	886-218	1		Mounting plate for TCR3/REC
	27	910-164	1		Thermal printer unit for TCR3/REC
	28	008-208	4		Screw, M2,5 x 8 mm
	29	921-424	1		Paper pin for TCR3/REC
	30	984-053			Thermo-sensitive paper for TCR3/REC, box with 6 rolls
	31	885-723	1		Right aluminum chassis
	32	037-316	4		Stand off for TCR3/REC
	33	901-747	1	*	Computer PCB assembly, histogram
		901-741	1	*	- standard
	34	885-725	1		Bracket for DIN connector, TCR3/REC
	35	805-423	1		DIN connector, 5-pole
	36	885-763	1		Rear aluminum chassis
	37	887-438	1		Left fixation bracket

Continued on next page

Available Spare Parts, *Continued*

Available Parts *(continued)*	Ref. No.	Part No.	Quantity	Description
	38	978-530	1	Rear panel, standard (run 1-5)
		978-531	1	Rear panel, histogram (run 1-5)
		978-566	1	Rear panel, standard (run 6 onwards)
		978-567	1	Rear panel for REC, histogram (run 6 onwards)
	39	008-902	4	Screw, M3 x 8 mm, black
	40	927-038	1	2-pole cable with connector
	41	927-003	2	Bottom rail kit for TCC3/TCR3/REC/BAT
	42	837-133	4	Rubber foot
	43	008-308	8	Screw, M3 x 8 mm
	44	046-901	8	Spring washer M3
	45	042-306	2	Washer, ø 3.2/7 x 0.5 mm
	46	885-705	1	Bottom plate for TCR3/REC, white
		885-797	1	- yellow
		885-798	1	- pink
		885-799	1	- green
		885-800	1	- blue
	47	885-731	2	Thread plate for TCR3/REC
	48	885-761	1	Cover for REC, white
		885-793	1	- yellow
		885-794	1	- pink
		885-795	1	- green
		885-796	1	- blue
	49	921-427	1	Cover for paper roll, TCR3/REC
	50	901-744	1	* Connector PCB assembly
	51	901-800	1	Optical paper detector
	52	842-169	4	Protection spacer for REC/BAT
	53	842-168	2	Protection spacer for fixation screw

Continued on next page

Available Spare Parts, *Continued*

Available Parts *(continued)*	Ref. No.	Part No.	Quantity	Description
	54	025-031	2	Fixation screw for REC, M4 x 5
	55	043-112	2	Washer, 4.1 x 11 x 1 mm
	56	923-165	1	Lock for REC
	57	012-203	1	Pointed screw
	58	876-834	1	Spring
	59	923-164	1	Lock-house
	60	008-110	4	Screw, M2 x 10
		904-729		Histogram updating kit consisting of EPROMs with histogram software, and rear plate.

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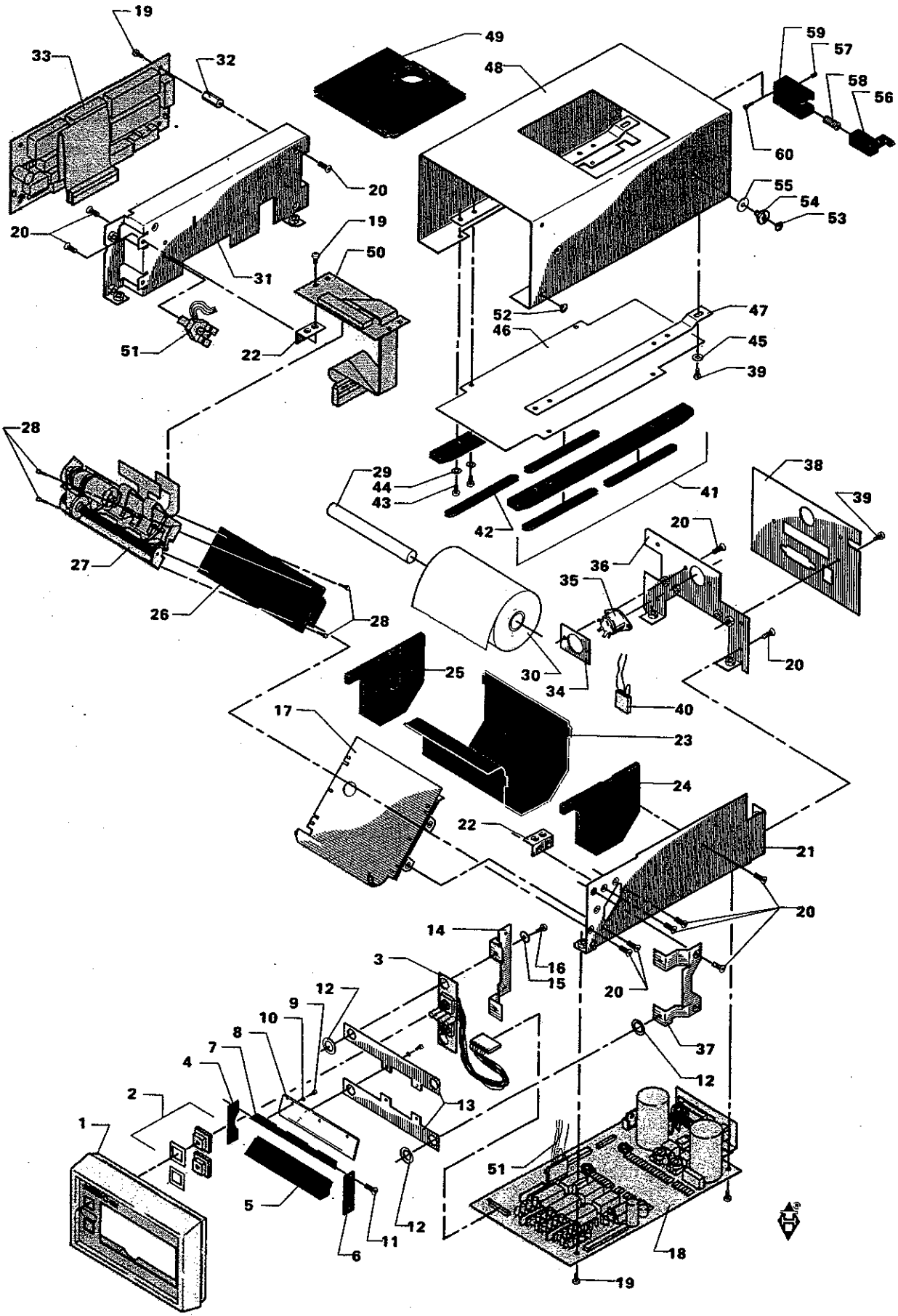


REC SERVICE PARTS

Circuits Description, REC

Overview

Introduction

This section gives detailed information as to build-up and function of the electronics. It provides the background information required for servicing the REC.

Contents

This section contains the following topics.

Topic	See Page
Computer PCB	48
Printer Control PCB	50

Computer PCB

General Description

The PCB includes the front panel control circuitry and the serial interface to the OXI and TCM3 monitors.

These and the thermal printer control functions are software controlled by the 8 bit CMOS microprocessor system NSC800 with its peripherals.

The memory consists of 8 kbyte RAM and 128 kbyte program memory. Some data, such as paper speed information, are stored in an EEPROM.

The circuitry is shown on the drawing 2410-A1.

Microcomputer

The microcomputer consists of the CPU (QD1), the program memory (QD3 and QD6), the data memory (QD8), the EEPROM (QD7) and the address latch (QD2).

The addressing takes place via the non multiplexed address bus A8-A15, the combined address/data bus AD0-AD7 and the address latch QD2.

Data transfer between the CPU, the memories and the other peripherals also takes place via AD0-AD7.

Some of the control functions, for example the memory mapping are performed by QD4, a programmable logic device which is UV light erasable.

The CPU oscillator is controlled by a 3.2 MHz crystal, setting the clock frequency to 1.6 MHz.

Continued on next page

Computer PCB, *Continued*

Input/Output

The microcomputer communicates externally with the help of the parallel port QD11 and the serial port QD10.

The input-output ports are organised as follows:

Part		Function
QD11	PA0	Write pulse input
	PA2	NMI enable
QD11	PB0	Motor ON/OFF output
	PB1	Alarm output
	PB2	Power check input from the Printer Control PCB
	PB3	Paper check input from the Printer Control PCB
	PB4-PB7	LED control signals for the front panel
QD11	PC0	EEPROM data input/output
	PC1	EEPROM enable output
	PC2	Clock output for the EEPROM
	PC4	System clock output

Part		Function
QD10	DCD	Timing input from QD3.
	CTS, DSR	Front panel key input signals

The incoming data from OXI/TCM3 is checked for errors and converted to parallel for transfer to the CPU.

When incoming data is detected, an interrupt is sent to the CPU (RSTC).

Printer Control PCB

General Description

The Printer Control PCB includes the control and drive circuitry for the thermal printer, rectifier and DC regulator circuits.

Included is also a galvanic isolated circuit for the alarm output.

The circuitry is shown on the drawing 2435-A1.

Rectifier Circuit

The mains adapter AC voltage is rectified and filtered by C17, C18, L3, CR1 and C9 to a DC voltage of nominal 15 V.

Via the rear panel D-connector pin 2 and 6, REC can be supplied from OXI or TCM3.

DC Regulators

The PCB includes 3 regulated dc sources.

QA1 is a standard linear +5 V regulator, supplying RECs IC circuits.

QA3, Q3 and associated components constitutes a step down switching regulator, supplying +5 V to the DC motor.

The writing head is supplied with +18 V from the step-up switching regulator QA2 and associated components.

The output voltage is adjustable by R11.

The circuit includes a high-input voltage detector. If the input voltage exceeds 21 V, the LBD voltage (pin 8) of QA2 will go high and activate the input excess voltage error code.

DC Motor Control

The motor speed is controlled by the D/A converter QD1, the buffer QA4b, the driver QA4a and the complementary power amplifier Q4/Q5.

The motor current is measured by QA4c, the output signal of which is added to the motor drive signal to obtain a negative Z amplifier.

This is necessary for the motor to overcome varying loads at low speeds.

QA4d is a paper run-out detector. Without paper, the optical detector will activate QA4. PAPER CHECK goes low and the microprocessor stops the motor by activating Q6.

Printing Control

The control circuit for the thermal printing head is constituted by the 20 Darlington driving transistors Q7 to Q26, one for each printing element, 3 data latches QD3, QD4 and QD5 and a mono-stable multi-vibrator QD2 for adjusting (R38) the printing pulse length.

Continued on next page

Printer Control PCB, *Continued*

Line and Dot Interrupt

The dot and line strobe signals from the printers' tacho disk are regenerated and combined by the two RS flip flops QD7 to form the line interrupt and dot interrupt signals.

Alarm

The opto-coupler QA5 and transistor Q27 form a galvanic isolated alarm output circuit. Max. power requirement to the external switching system is 24 V, 250 mA.

Test Points

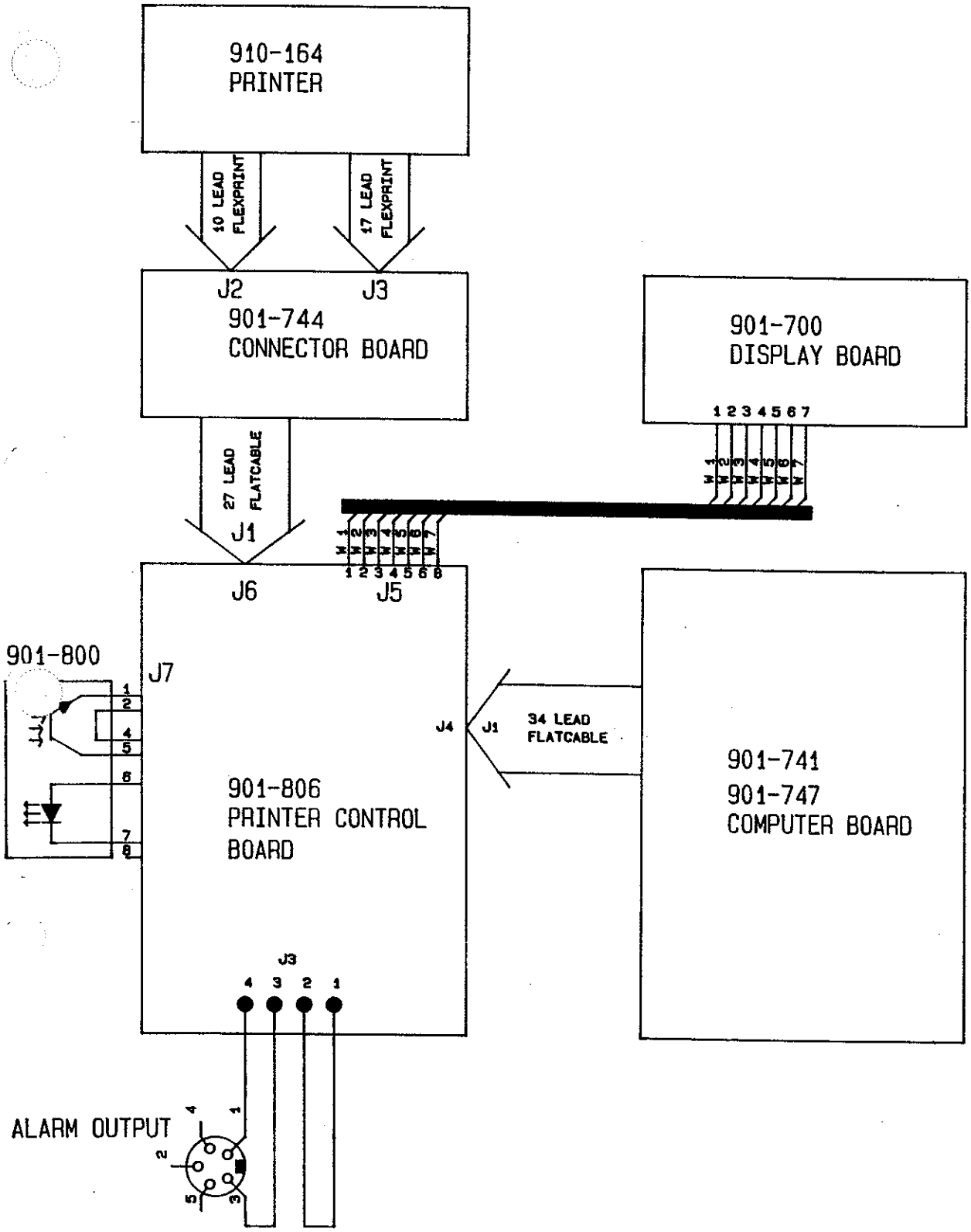
The PCB includes the following test points.

Test Point	Function
TP1	Ground
TP3	Printing pulse
TP4	Motor feed back signal
TP5	+5 V supply for motor
TP6	+5 V general
TP7	Rectifier voltage
TP8	Printing head voltage

Thermal Printer PU2040

The Olivetti PU2040 thermal printer consists of a DC motor, a printing head with 20 thermal resistor components, a mechanical cam system for horizontal movement of the printing head and a tacho disk delivering dot and line strobe signals for the printer electronic control system.

Each of the 20 thermal printing components covers 14 horizontal dots. This gives a total resolution of 280 dots pr. line.



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INTERCONNECTION DIAGRAM
000-110

type REC3
from no. to no.

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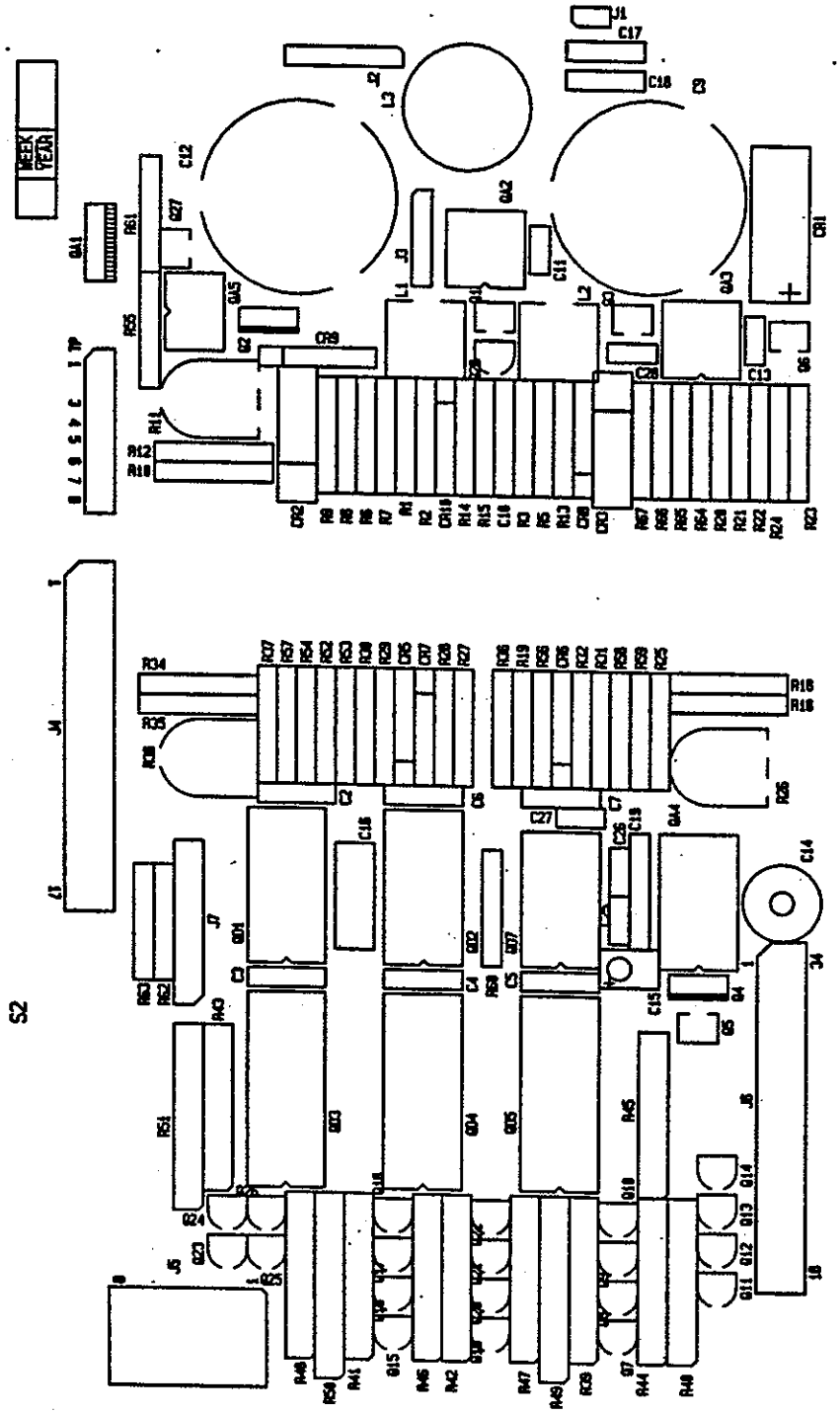
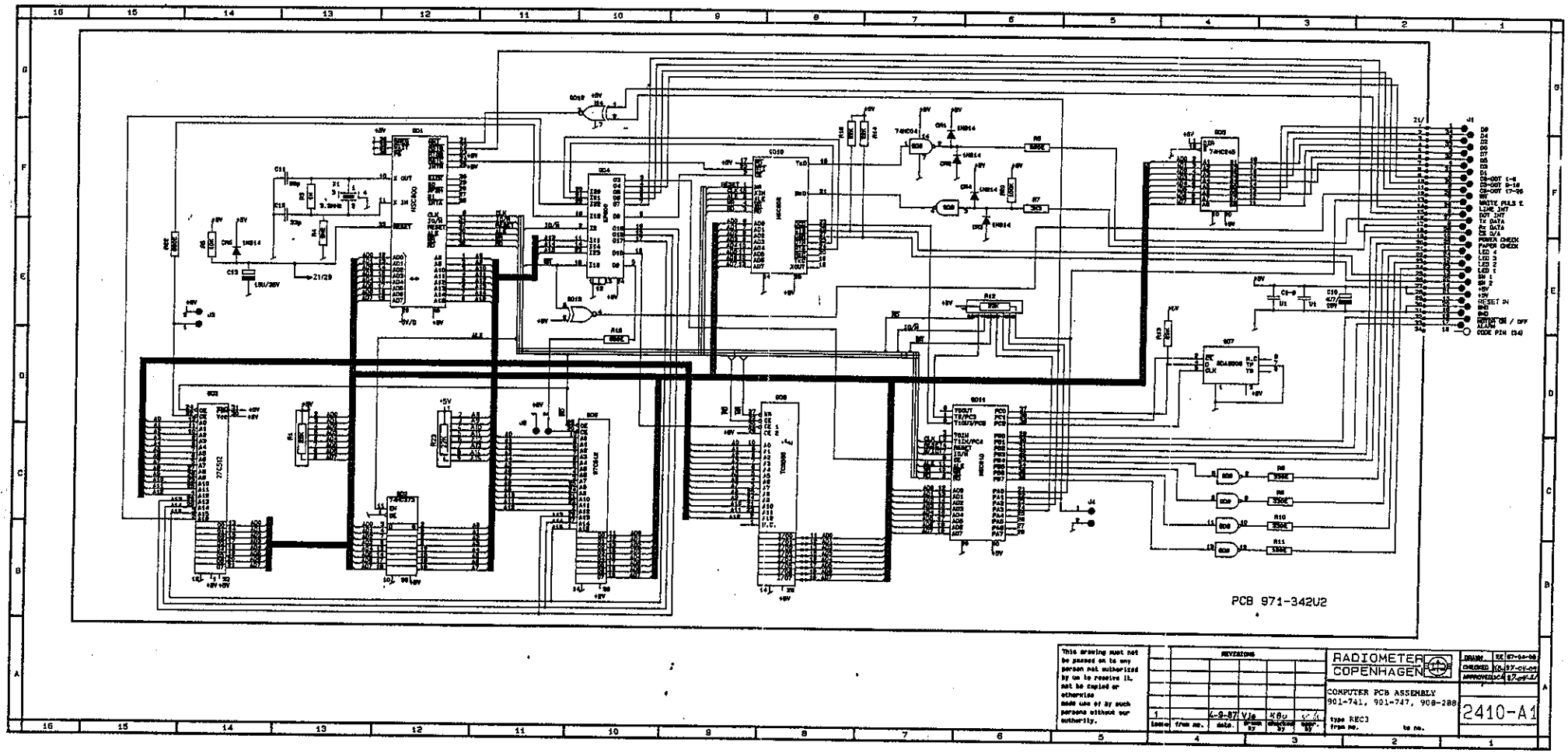
CHECKED	KBu	02.09.87
APPROVED	SCh	03.09.87

6762-A3



REC Printer Control PC-Board 901-806
Component layout



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COMPUTER PCB ASSEMBLY
901-741, 901-747, 908-288

type REC3
from no. to no.

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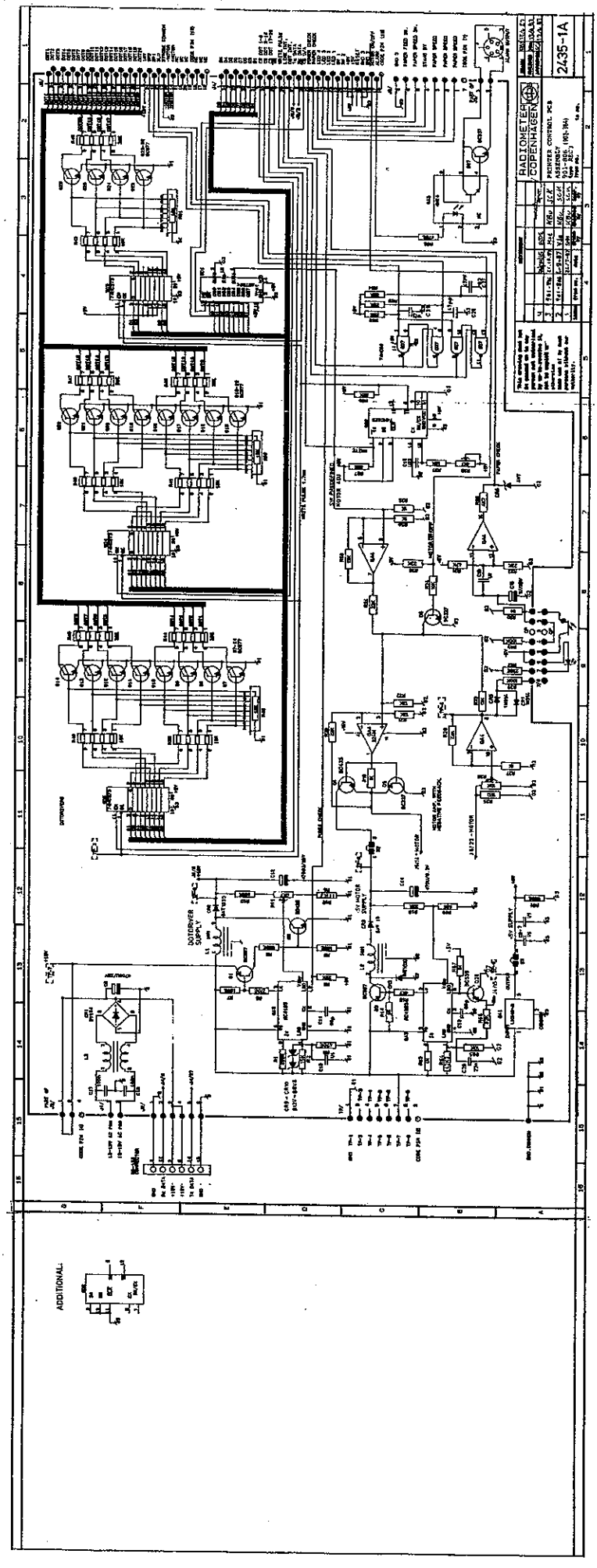
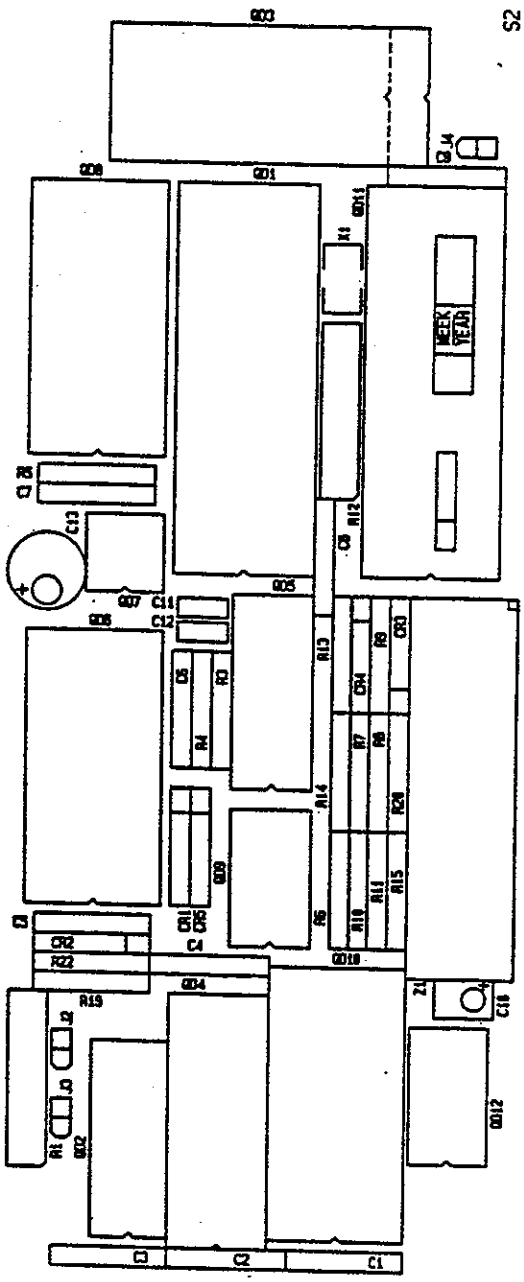
CHECKED KBH 87-04-06
APPROVED 87-09-07

2410-A1


RADIOMETER COPENHAGEN
2435-1A
ADDITIONAL



REC Microcomputer PC-Board 901-741/901-747
Component layout

6. Accessories

Battery Unit, Electrode Simulator, and Mains Adapter

Introduction

This part gives detailed information about the function and servicing of the battery cassettes, electrode simulator and mains adapters.

Contents

This chapter contains the following topics.

Topic	See Page
TCB3	3
BAT	13
TC Electrode Simulator	25
Mains Adapter	33

TCB3

Overview

Introduction

This part gives detailed information about the function and servicing of the battery cassette TCB3.

Contents

This section contains the following topics.

Topic	See Page
General Information	5
Dismantling and Replacements	7
Spare Parts	9
Circuits Description	11

General Information

Introduction

The Battery Cassette is provided as a power supply for the TCM3 during transport.

It contains 6 alkaline type LR 20 (US size D) batteries, enough for approximately 12 hours of operation.

It is attached to the Monitor by a 1/4 Turn Hinge and electrically connected via the 15 pole connector on the rear panel.

The cassette includes a battery indicator which is activated when the cassette is attached to the Monitor.

Dismantling and Replacements

Introduction

For the dismantling and replacement of the parts in the TCB3, the following tools are necessary:

- Pozidrive screwdriver # 1
- Wrenches for 4 and 14 mm nuts.
- Pliers
- Cyanolite adhesive, 991-035.

The numbers in brackets refer to the exploded view.

Battery Change (18)

Step	Action
1.	Unscrew the battery cover (1) and replace the batteries (18). Ensure that the polarity is in accordance with the labels printed next to the battery tubes (17).

Note that all 6 batteries must be changed at a time.

Battery Indicator and Internal Cable (23)

The Battery Indicator, the cable with components and the 15 pole connector constitute one service part (23).

Step	Action
1.	Remove the cover (19) by unscrewing the 2 screws.
2.	Disconnect the cable terminals from the battery springs (20) and the cover (19). If a tool for removing the crimped connector pins from the connector house is available, it is not necessary to remove the connector and the cassette cover. If this is not the case, it will be necessary to cut the cable at the connector and dismantle the entire battery cassette.
3.	Unscrew the nut (10), loosen the 2 screws (15) which secure the battery tubes, and remove the cover (13).
4.	The battery indicator is fastened in place with a cyanolite adhesive product, the so-called Loctite. Using pliers, carefully twist it loose and draw the entire cable out through the battery indicator hole.
5.	After the replacement cable is fitted, the battery indicator must be fastened in place with the cyanolite adhesive. CAUTION: The adhesive must not come into contact with the skin. Use plastic gloves or similar.

Continued on next page

Dismantling and Replacements, *Continued*

Battery Indicator and Internal Cable (23) *(continued)*

Step	Action
6.	Connect the negative battery terminal (the one with 4 leads) to the spring which is closest to the connector.
7	Ensure that the battery springs (20) fit correctly into the tubes (17) and that the cable is not clamped when the cover (19) is refitted.

Spare Parts

Introduction

All spare parts available for the TCB3 are listed in this section which also includes an exploded view to ease the identification of the parts.

When ordering spare parts include the code number and the description of the part.

Available Spare Parts

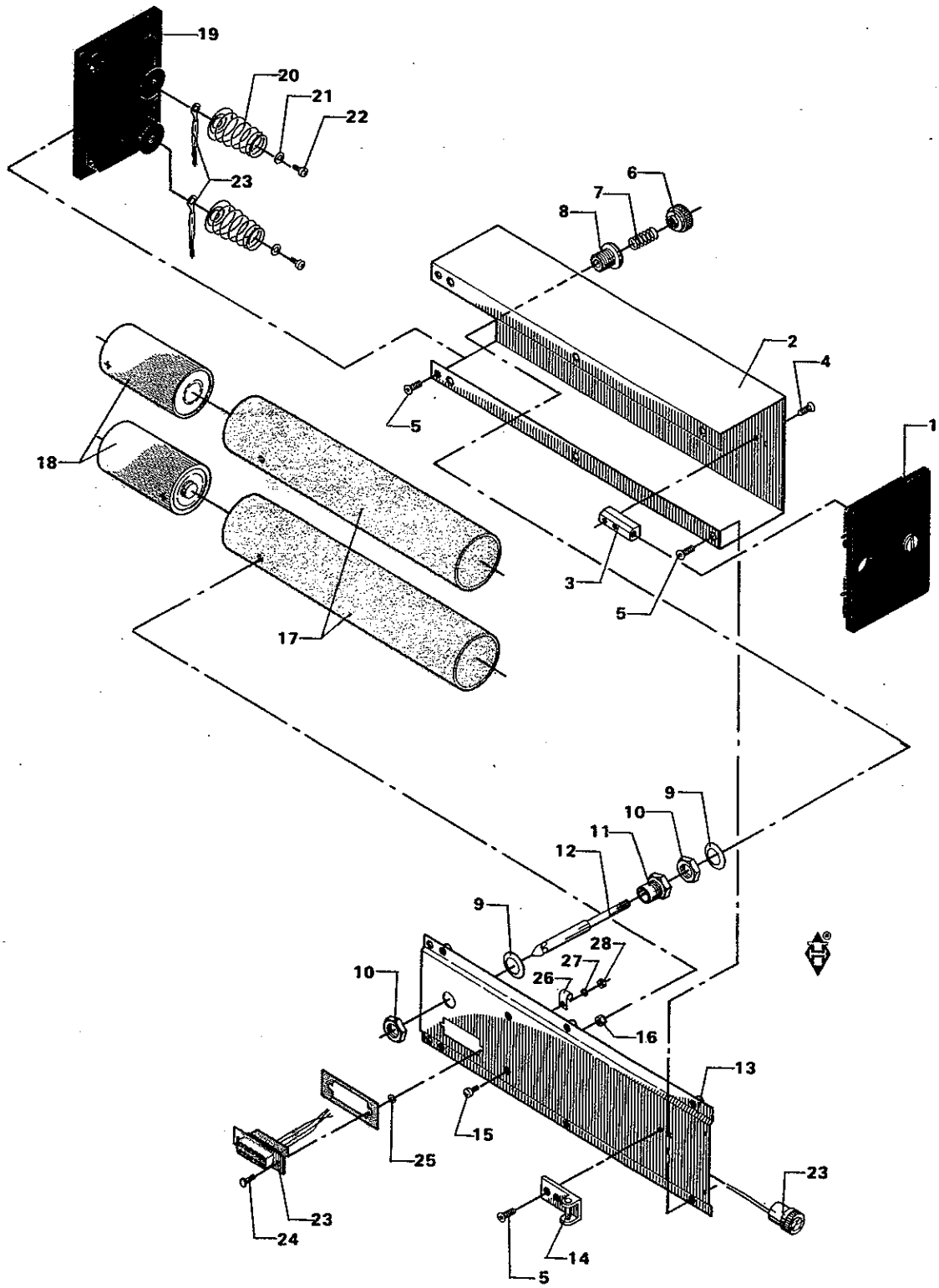
The numbers in the left column refer to the exploded view at the end of this Section.

Ref. No.	Part No.	Quantity	Description
1	927-012	1	Battery Cover for TCB3, complete
2	885-711	1	Cover for TCB3
3	885-715	1	Bracket for Battery Cover, TCB3
4	009-308	2	Screw, M3 x 8, countersunk
5	009-306	10	Screw, M3 x 6, countersunk
6	035-216	1	Fingerscrew for TCB3
7	856-220	1	Spring for TCB3
8	923-126	1	Spring Holder for TCB3
9	046-412	2	Spring Washer for TCB3
10	032-901	2	Nut, M10 x 1
11	065-839	1	Bushing for TCB3
12	872-509	1	Spindle for TCB3
13	885-717	1	Lid for TCB3
14	927-011	1	Hinge for TCB3, complete
15	008-312	2	Screw, M3 x 12
16	035-503	2	Nut with lockring for TCB3
17	927-010	1	Set of Battery Tubes for TCB3, complete
19	927-013	1	Battery Lid for TCB3, complete
20	876-862	2	Battery spring for TCB3
21	046-902	2	Washer
22	008-408	2	Screw, M4 x 8
23	636-016	1	Cable for TCB3, complete. Battery indicator and female D connector included.

Continued on next page

Spare Parts, *Continued*

Available Spare Parts *(continued)*	Ref. No.	Part No.	Quantity	Description
	24	020-906	2	Screw, M2.5
	25	042-105	2	Washer, M2.5
	26	064-505	1	Cable guard
	27	046-904	2	Spring washer
	28	031-250	2	Nut, M2.5

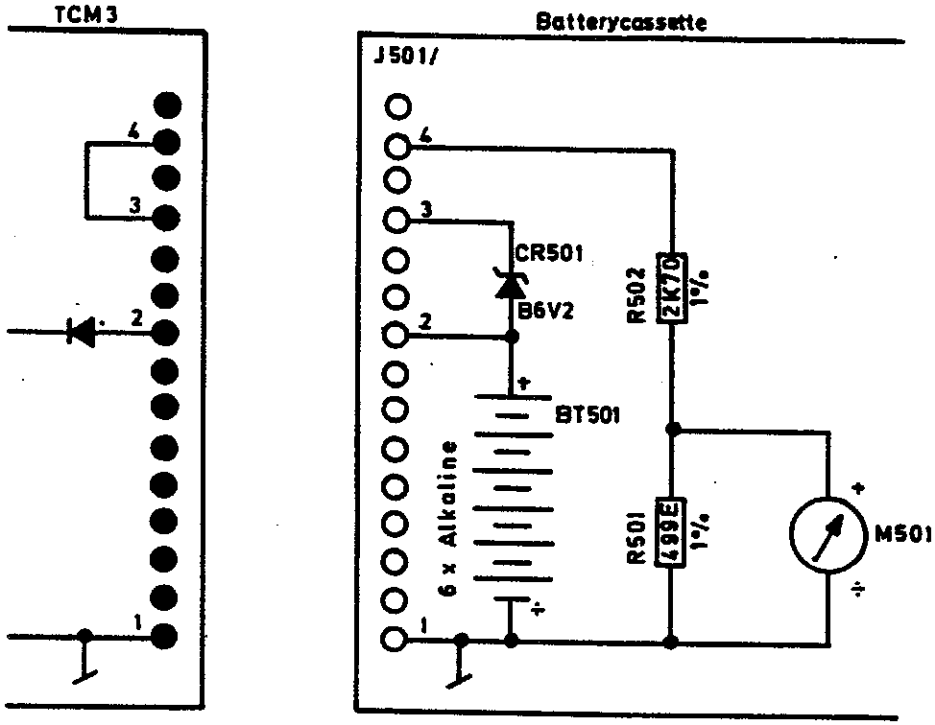


TCB3 SERVICE PARTS

Circuits Description

Description

The figure below shows the TCB3 diagram and the Monitor rear connector with the pins used for the supply.



The TCM3 is supplied via terminal 2. The series diode protects the Monitor against incorrect battery polarity.

The battery indicator is activated via the strap between terminals 3 and 4. CR501, R501 and R502 adapt the indicator to the battery voltage.

BAT

Overview

Introduction

This part gives detailed information about the function and servicing of the battery cassette BAT.

Contents

This section contains the following topics.

Topic	See Page
General Information	15
Test Procedures	17
Dismantling and Replacements	19
Spare Parts	21
Circuits Description	23

General Information

Introduction

BAT contains a rechargeable lead-acid 12 V battery, and is intended to supply OXI and TCM3/30 during transport, where the monitor's internal battery capacity is insufficient.

BAT makes OXI functioning approximately 6 hours, and TCM3/30 approximately 8 hours, in excess to the internal battery time.

When BAT is empty, OXI and TCM3/30 will continue to work on their internal battery. This is indicated by activation of the bat light-bar on the monitor's front panel.

BAT is rechargeable either via the mains adapter directly or indirectly via OXI or TCM3/30, when they are supplied from the mains. But only if the monitors are switched off.

If BAT is charged directly from the mains adapter, it takes approximately 12 hours for a full recharge.

If it is charged from OXI or TCM3/30, the charging time is approximately 14 hours.

TCM3s with production below 22, can be supplied from, but cannot charge BAT.

Charging Condition

On its front BAT has four light bars, displaying different charging conditions.

Activated Light Bar	Function
~	BAT is being charged. This light bar is activated together with one of the light bars below.
	BAT is empty (low)
	BAT is half full (medium)
	BAT is full

When BAT supplies the monitor, either or lights.

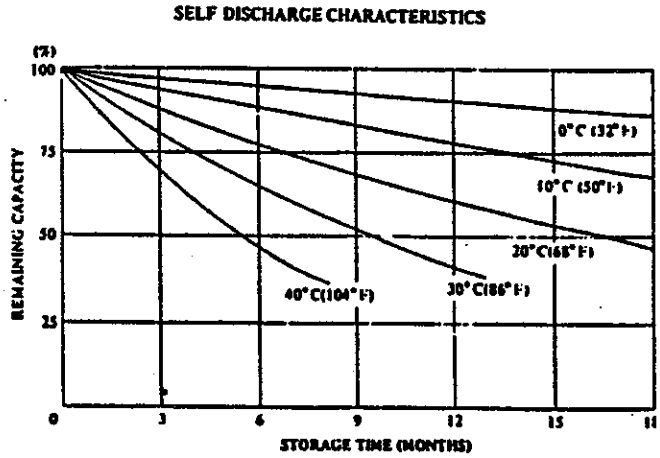
Even the battery is protected from being deeply discharged, it is recommended to recharge BAT shortly after use.

Continued on next page

General Information, *Continued*

Charging Condition ***(continued)***

All batteries are exposed to a certain self discharge. The figure below shows BAT's self discharge characteristics at different temperatures.



Test Procedures

Introduction

This section describes the necessary procedure for checking and adjusting BAT.

It is intended that repairs to BAT are made only by replacing those service parts which are defined in the spare part section.

The Charging Control PCB assembly is included in our trade-in arrangement and must be returned to RADIOMETER for replacement.

Radiometer recommend a yearly preventive maintenance check.

If the battery or the Charging Control PCB is changed, the checkout and adjustment must be carried out.

Required Tools

To carry out the checkout and adjustment procedure, the following accessories are necessary:

- 3 1/2 digit digital voltmeter.
- Adjustment tool for the trimming potentiometer.
- 1 kohm 1/4 W, 5 % resistor.
- 68 ohms 2 W, 5 % resistor.

Caution

When disassembling BAT, be careful not to short circuit the battery. It has high capacity and low internal resistance, and short circuiting the battery will definitely cause damage.

End of Charge Voltage and BAT Full LED

Step	Action
1.	Carefully disconnect both battery leads. Instead of the battery, connect the DVM to the leads (red lead to DVM+, black lead to DVM-). Connect a 1 kohm 1/4 W, 5 % resistor across the DVM terminals.
2.	Connect BAT to the mains via the mains adapter and check that the DVM shows 13.80 ± 0.1 V and that the BAT full LED lights. If outside, adjust R19 on the Charging Control PCB to 13.80 ± 0.1 V.

Battery Medium LED

Step	Action
1.	Replace the 1 kohm resistor with a 68 ohms 2 W, 5 % resistor and check that the bat-medium LED lights.

Continued on next page

Test Procedures, *Continued*

Battery Low LED

Step	Action
1.	Disconnect the resistor and the mains adapter. Discharge BAT to a battery voltage of 11.4 V. Check that the BAT empty LED lights.
2.	Connect an ampere meter in series with one of the battery terminals. Start recharging the battery from the mains adapter and check that the charging current is 600 ± 50 mA.

Repair

If the charging current is not within the stated tolerances or the LEDs do not light as indicated, the Charging Control PCB should be replaced.

Dismantling and Replacements

Introduction

The following tools are necessary:

Pozidrive screwdriver, # 1

Wrench for the 6 mm hexagonal stand-offs

Dismantling

Step	Action
1.	Dismantle the rear plate (29) by unscrewing the three screws. Be careful not to lose the lock lever (32) and the spring (31).
2.	Disconnect the mains adapter socket from the rear plate.
3.	Unscrew the 4 side screws and carefully draw forward the front panel with the battery.
4.	Lift off the chassis from the battery, and dismount the two power semiconductors from their heat sink (14).
5.	Unscrew the chassis (10) from the front panel stand offs (7).
6.	The Charging Control PCB assembly (2) is removed by unscrewing the four stand-offs (7) and disconnecting the two battery leads from the battery.

Reassembly

Step	Action
1.	Connect the battery leads correctly!! Red lead to red battery terminal and black lead to black battery terminal.
2.	Mount the isolation plates and the washers before fixing the two power semiconductors to the heat sink.
3.	Mount the isolation plate (9) and be careful not to clamp the four leads when remounting the chassis.
4.	Turn the slit in the mains adapter socket towards the edge.
5.	Position the spring in the middle of the housing for the lock lever before mounting the lock lever.

Spare Parts

Introduction

All spare parts available for BAT are listed in this section, which also includes an exploded view to ease the identification of the parts.

When ordering spare parts, include the code no. and the description of the part.

Trade-in Parts

If defective, the Charging Control PCB assembly must be returned to RADIOMETER for replacement. This is to ensure the highest possible degree of patient and functional safety.

It will be replaced in accordance with our trade-in arrangement for modules, with the exception of modules that have been damaged during attempted repairs.

Available Spare Parts

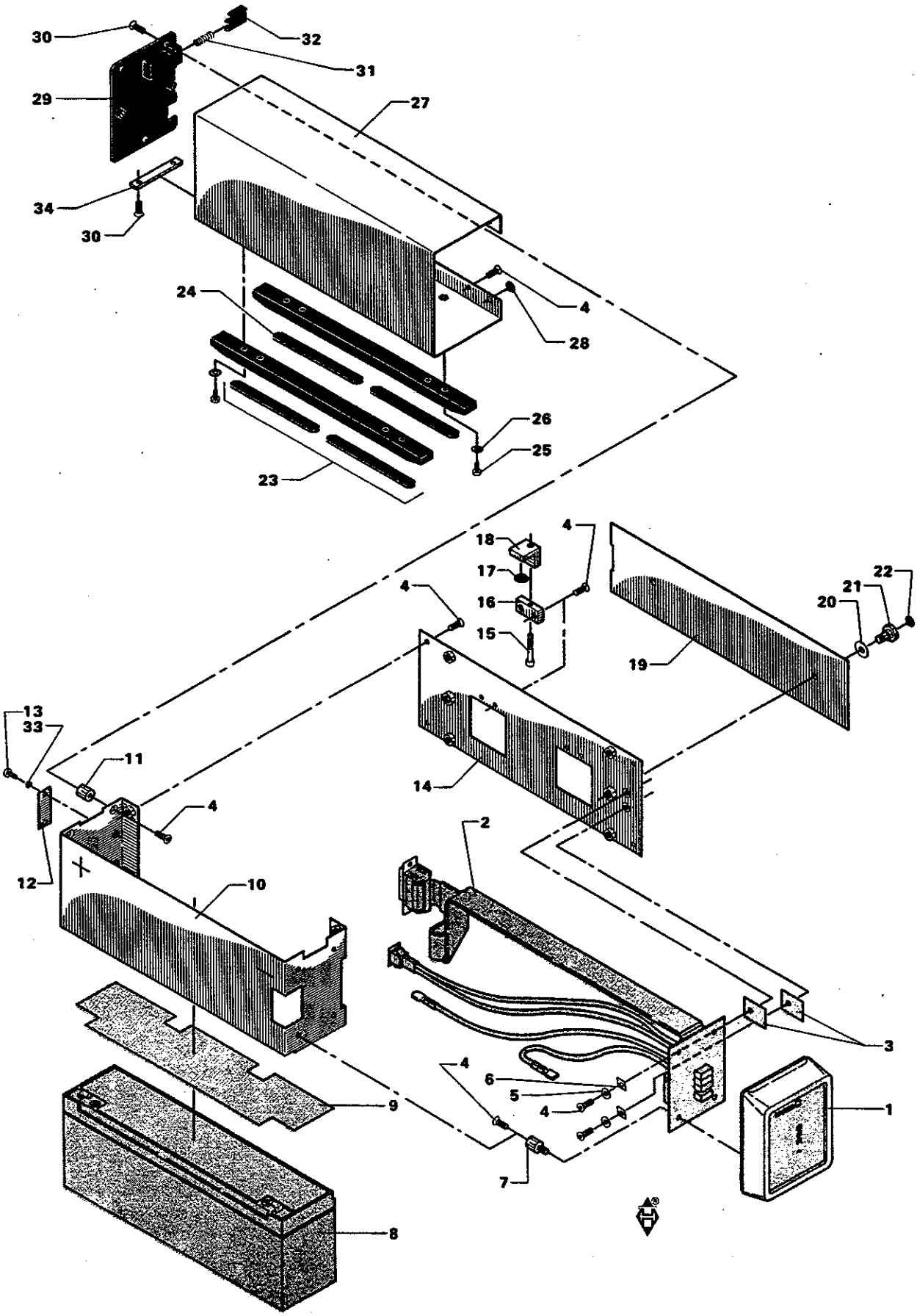
The numbers in the left column refer to the exploded view at the end of this Section.

Ref. No.	Part No.	Quantity		Description
1	927-039	1		Front Panel for BAT, white
2	901-745	1	*	Charging control pcb assembly for BAT
3	816-163	2		Transistor isolation plate for BAT
4	009-306	12		Screw, M3 x 6 mm, countersunk
5	042-307	2		Washer
6	816-239	2		Isolation bushing for BAT
7	039-801	4		Stand-off for BAT
8	431-009	1		Lead-acid battery for BAT
9	886-262	1		Isolation plate for BAT
10	978-537	1		Chassis for BAT, silk screened
11	037-307	3		Stand-off for chassis, BAT
12	885-812	1		Bracket for flat cable, BAT
13	008-306	2		Screw, M3 x 6 mm
14	885-779	1		Aluminum side plate for BAT
15	010-316	2		Hex-head screw for BAT
17	837-428	2		Rubber pad for BAT
18	887-437	2		Adjustment bracket for BAT
19	885-788	1		Side plate for BAT, white

Continued on next page

Spare Parts, *Continued*

Available Spare Parts *(continued)*	Ref. No.	Part No.	Quantity	Description
	20	043-112	2	Washer 4.1 x 11 x 1 mm
	21	025-032	2	Fixation screw for BAT, M4 x 9.4 mm
	22	842-168	2	Protection spacer for fixation screw
	23	927-003	2	Bottom rail kit for TCC3/REC/BAT
	24	837-133	4	Rubber foot
	25	008-305	8	Screw, M3 x 5 mm
	26	042-306	8	Washer, M3
	27	927-044	1	Cover for BAT, white
	28	842-169	4	Protection spacer for REC/BAT
	29	978-534	1	Rear plate for BAT, silk screened
	30	009-305	5	Screw, M3 x 5 mm, countersunk
	31	876-052	1	Spring for BAT
	32	923-188	1	Lock for BAT
	33	046-901	2	Spring washer, M3
	34	885-811	1	Thread plate for BAT



BAT SERVICE PARTS

Circuits Description

Charging Control PCB

The PCB includes a rectifier and power regulator circuit, a charging control circuit, a display control circuit and a battery-low detector

Rectifier and Power Regulator

The four diodes CR1-CR4 rectifies the ac voltage from the mains adapter. Filtering and regulation is performed by C2, C4 and QA1, supplying the charge current for the battery.

Alternatively, if BAT is charged from OXI or TCM3/30, the charge current is supplied via CR14.

When OXI or TCM3/30 is supplied from BAT, then BAT's own display is supplied via CR14.

TCM3 below R22 cannot charge BAT, but if supplied from BAT, then BAT's own display is supplied via CR17.

Charging Control

The DC regulator QA4 supplies the display and the charge regulator with 7.5 V.

Two reference voltages control the battery charging condition.

The max. charging current is controlled by the reference voltage in the node R18/R21. It is factory adjusted to 72 mV.

The battery end-of-charge voltage is controlled by the reference voltage in the node R18/R20. It is adjustable by the potentiometer R19. Typical value; 1.50 V.

The current is regulated by the integral regulator QA2a/C5, and Q1 and QA1.

The regulation system will keep the charging current at a level that equals V_{R9} to the reference voltage V_{R21}.

If BAT is charged from the mains adapter and also connected to OXI, the charging current passes R9 and the OXI consumption current passes R9 and R10. Q9 will be activated and V_{R10} will affect the current regulation loop, helping QA1 to keep its output current constant.

Please notice that the charging current will be reduced by the same amount that the consumption increases, and vice versa.

If BAT is charged from OXI, then Q9 will be off, and V_{R10} will not affect the regulation loop.

The end-of-charge voltage regulation is performed by QA2b and associated components.

When the battery has been charged to a level that makes the potential at QA2b pin 5 to equal that of pin 6, then the output will go high and the current in R32 and CR8 will influence the current regulation loop and reduce the charging current.

Continued on next page

Circuits Description, *Continued*

Display Control

When the battery has been fully charged (13.80 V), QA2b pin 7 will go high, QA3a pin 1 will go high impedance (open collector output) and Q8 will saturate and activate the battery full LED CR12.

The battery medium LED CR11 will switch off as Q7's base current will be shorted by CR9.

When the battery has been discharged (11.20 V), QA3b pin 7 will go low, the battery empty LED CR10 will be activated and Q7 will cut off and switch off the battery medium LED CR11.

CR11 is on when the battery voltage is between 11.2 and 13.8 V. (QA3a pin1 low and QA3b pin 7 high).

When the battery is charged from the mains adapter, Q5 will be saturated and activate the charge LED CR13 via Q6 and Q10.

When it is charged from OXI, the charge LED will be activated via Q4.

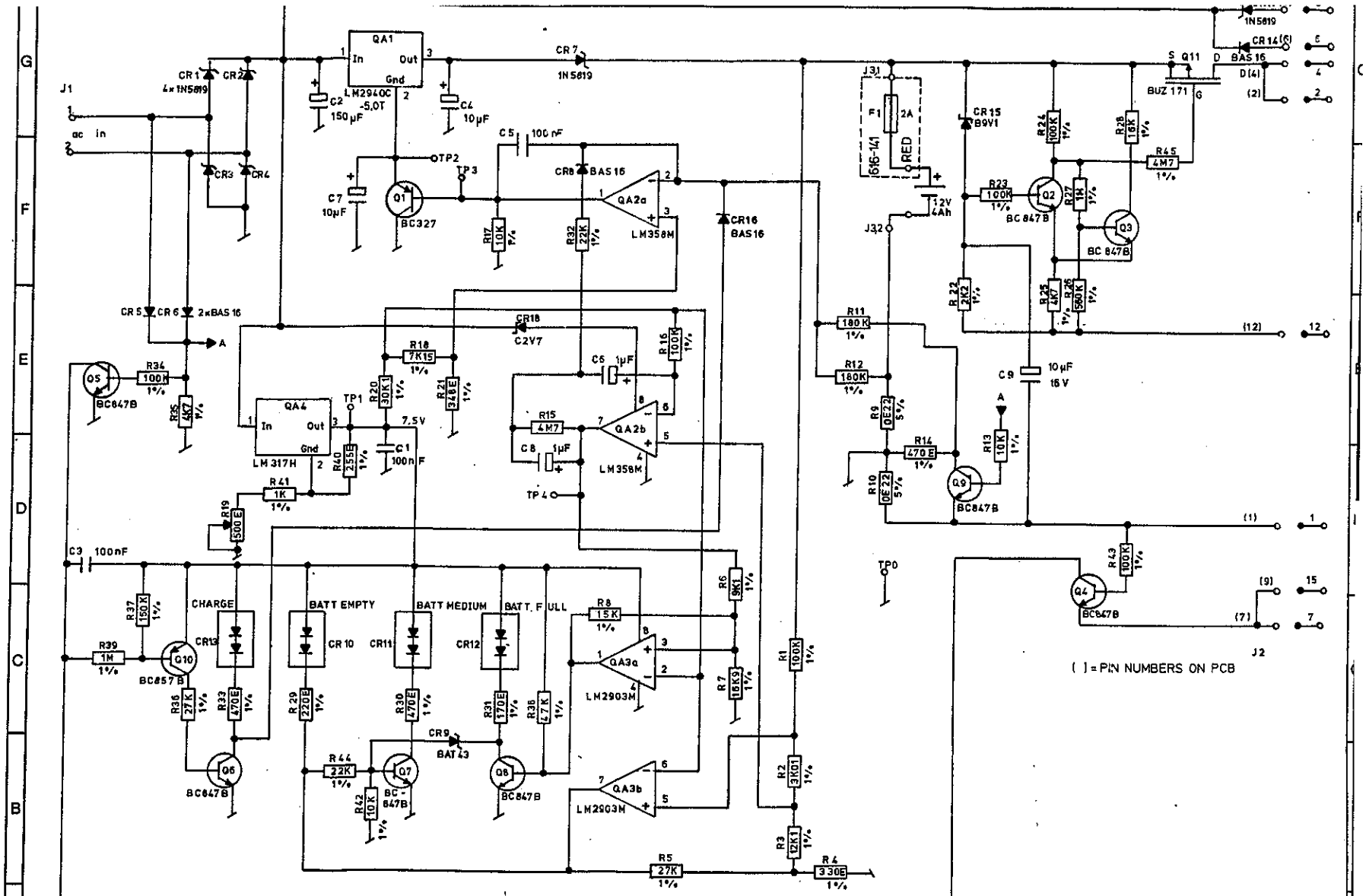
The battery is charged only if the charge LED is on, as the current regulation loop is influenced by the Q6 collector potential via CR16.

Battery Low Detector

The battery is protected against deep discharge by the power FET switch Q11.

When the battery voltage falls to below 10.2 V during discharge, Q2 and Q11 will cut off.

Q3 gives the circuit a certain hysteresis, preventing the circuit from oscillating due to battery regeneration.



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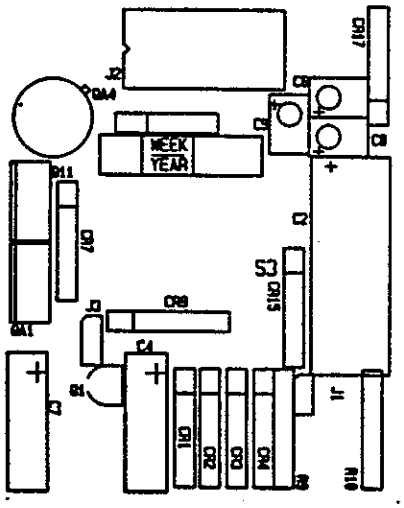
REVISIONS					
1		6-8-87	VJe	LSc	
2		14-10-87	VJe	LSc	SCM
3		27/10/88	SP		
4		26.8.94	OH		

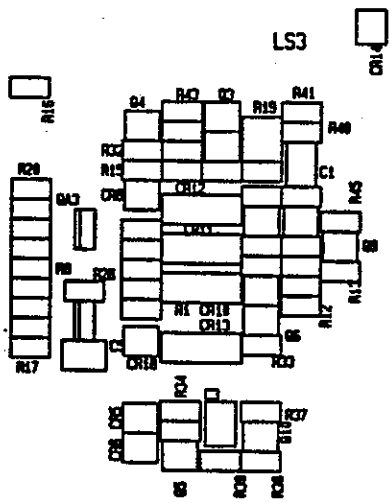
RADIOMETER COPENHAGEN

CHARGING CONTROL PCB ASSEMBLY
901-745 (908-402)
TYPE BAT3

DRAWN BY PBD 17/6 87
CHECKED BY LSc 17/6 87
APPR BY SCM 17/6 87

A2-3856





Front panel side

BAT Charging Control PC-Board 901-745
Component layout

TC Electrode Simulator

Overview

Introduction

This part gives detailed information about the function and servicing of the TC electrode simulator.

Contents

This section contains the following topics.

Topic	See Page
General Information	27
Test Procedures	29
Circuits Description	31

General Information

Introduction

The TCM3/30 Electrode Simulator, 901-705, is used to perform a Checkout and Adjustment procedure of the Monitor.

During the Checkout and Adjustment, the Simulator is connected to the TCM3/30 by two control cables:

- Electrode Control Cable. Code 617-854
- Output Control Cable. Code 617-855

Test Procedures

Required Tools

For carrying out this procedure a 5½ digit DMV with an accuracy equal to or better than 0.02% +2 digits is required.

Test Sources

This procedure is used for checking and adjusting the two test sources +1 mV and +185 mV. The procedure must be carried out at regular intervals. Once a year is recommended.

Step	Action
1.	Remove the lid by unscrewing the 4 side screws.
2.	Connect the Simulator to the Monitor by the Electrode Control Cable 617-854 and switch on the Monitor.
3.	Connect a 5 1/2 digit Digital Voltmeter to the Simulator. DVM+ to TEST SOURCE +185 mV, DVM- to TEST INPUT ground.
4.	Check that the DVM shows 185.00 mV ± 0.10 mV. If outside, adjust P1 on the PCB to 185.00 mV ± 0.05 mV P1 is adjusted through the chassis hole between the OUTPUT and ELECTRODE switches.
5.	Connect DVM+ to TEST SOURCE +1 mV. Check that the DVM shows 1.00 mV ± 0.05 mV

Circuits Description

Introduction

Please refer to the diagram 3743-A2.

Function Switches

The Simulator includes four functional switches:

Part	Function
S1	The THERMISTOR switch is used to simulate single or double thermistor electrodes.
S2	The TEMPERATURE switch has three positions. 37, 45 and 46 °C.
S3	The OUTPUT switch selects between the analog output plugs and a special data loop back test where the output serial data are looped back to the input and verified.
S4	The ELECTRODE switch is normally in the TEST position during the checkout and adjustment procedure. However, the electrode coding system in the TCM3 can be checked by help of the positions pO_2, pCO_2 and pO_2/pCO_2.

+1 and +185 mV

The test voltages +1 mV and +185 mV are derived from a precision voltage source AD580.

These voltages are used for the test of the pCO_2 channel.

-680 mV

The - 680 mV is used for the test of the pO_2 channel.

Analog Outputs

The Simulator has four ANALOG OUTPUT plugs, the two of which are used for the existing pO_2 and pCO_2 outputs.

The plugs 3 and 4 are reserved for future extensions.

DC Input

During the TCM3/30 Checkout and Adjustment procedure the Monitor can be power supplied from an external DC source via the DC INPUT terminals.

The maximum voltage is 21 Volts.

The DC INPUT terminals are protected against opposite polarity by the parallel diode CR3.

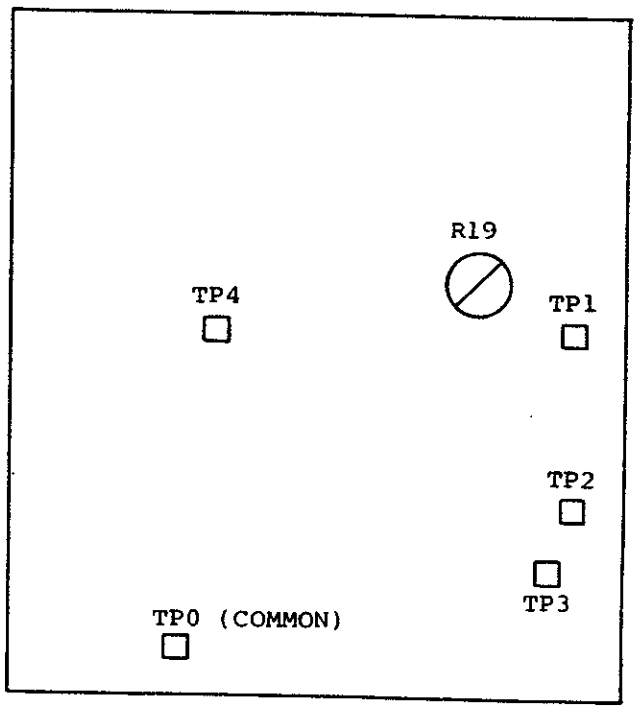
Temperature Switch

The TEMPERATURE switch (A and B) is a double switch for max. 2 x 6 positions. In the standard version it is locked to 2 x 3 positions and the resistors R7 to R12 are not mounted.

Continued on next page

Circuits Description, *Continued*

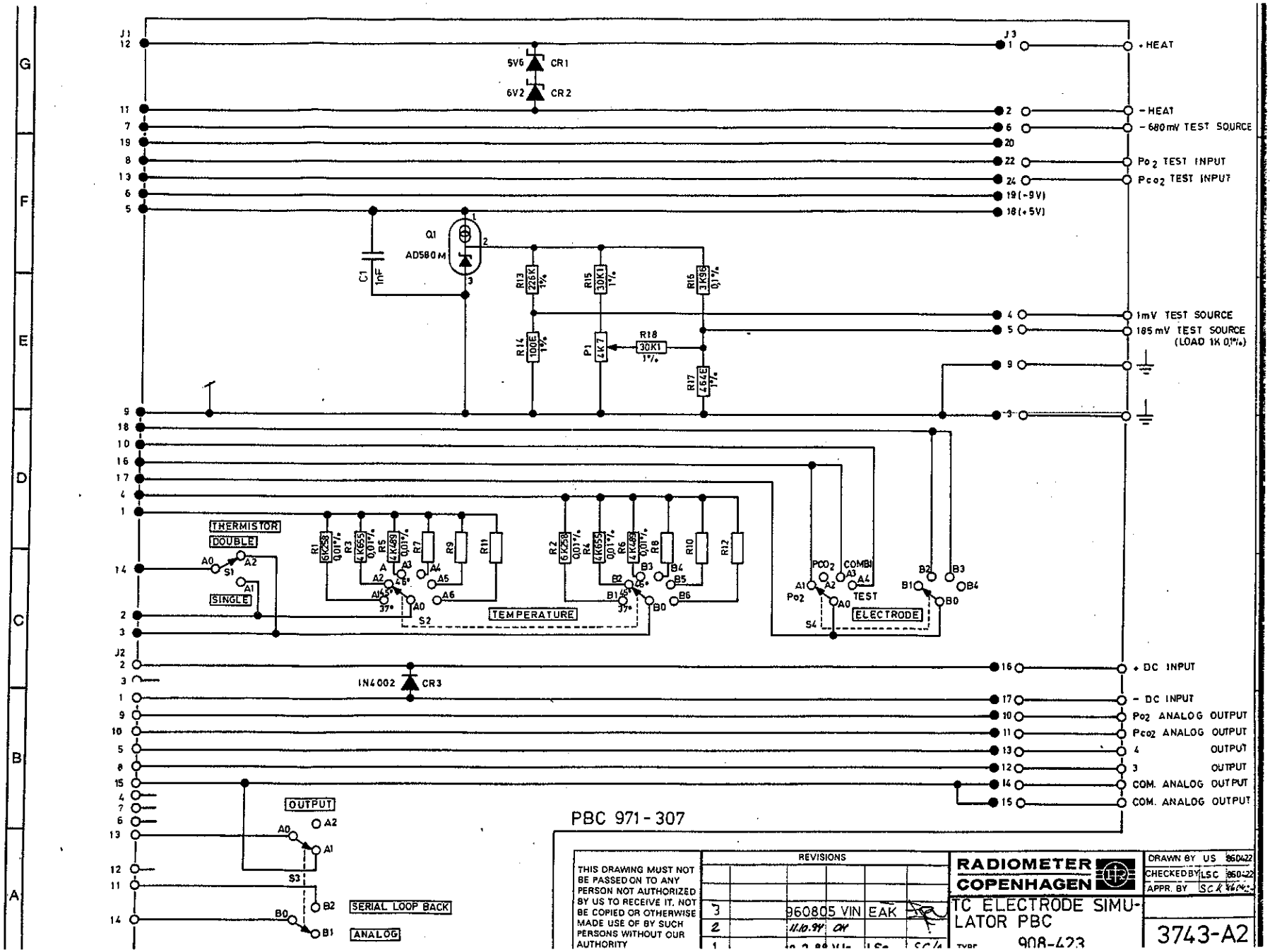
Heat Source The two zener diodes CR1 and CR2 load the Monitor Heat source during test.



TEST POINTS AND ADJUSTMENT COMPONENTS

FRONT PANEL SIDE

CHARGING CONTROL PC-BOARD ASSEMBLY 901-745


+HEAT
-HEAT
-680mV TEST SOURCE
Po2 TEST INPUT
Pco2 TEST INPUT
1mV TEST SOURCE
185 mV TEST SOURCE (LOAD 1K 0,1%)
+DC INPUT
-DC INPUT
Po2 ANALOG OUTPUT
Pco2 ANALOG OUTPUT
4 OUTPUT
3 OUTPUT
COM. ANALOG OUTPUT
COM. ANALOG OUTPUT
5V6 CR1
6V2 CR2
IN4002 CR3
Q1 AD580M
C1 1nF
R13 226K 1%
R15 30K1 1%
R16 3K99 0,1%
R14 100E 1%
P1 2K7
R18 30K1 1%
R17 464E 1%
THERMISTOR
DOUBLE
SINGLE
TEMPERATURE
ELECTRODE
TEST
OUTPUT
SERIAL LOOP BACK
ANALOG
PBC 971-307
RADIOMETER COPENHAGEN
TC ELECTRODE SIMULATOR PBC
TYPE 908-423
3743-A2
DRAWN BY US 860422
CHECKED BY LSC 860422
APPR. BY SCA 860422
REVISIONS
3 960805 VIN EAK
2 11.10.94 OK
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Mains Adapter

General Information

Introduction

This section gives an overview of the available mains adapters.

The adapter is a transformer with a secondary voltage of 12.5 V_{RMS}

The adapter exists in seven different versions listed below with their main data.

The adapters are designed for mounting directly in the mains plug except 904-707, 904-708 and 904-033 which are "table" types with a 2 m mains cable.

All versions are fitted with 2 m cable (secondary side). 927-058.

Different Types

The following seven different types exist:

Part Number (adapter)	Mains Voltage	Fuse	Part Number (fuse)
904-700	220 V (EU)	160 mA slow (primary)	450-012
904-707	220 V (EU)	160 mA slow (primary)	450-012
904-701	240 V (UK)	140 mA slow (primary)	Not supplied
904-602	120 V (US)	3 A slow (secondary)	Not supplied
904-698	100 V (Japan)	315 mA slow (primary)	450-015
904-708	120 V (CSA)	250 mA slow (primary)	450-014
904-833	240 V (UK)	140 mA slow (primary)	Not supplied

Please note that the US adapter 904-602 cannot be disassembled.